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Yasunaga

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(54) **RESIN-SEALED SEMICONDUCTOR DEVICE**

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(58) **Field of Classification Search**

None

See application file for complete search history.

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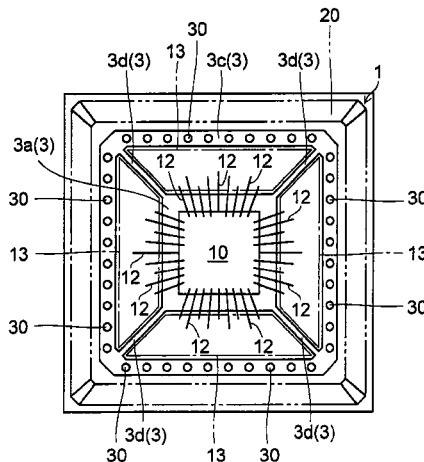
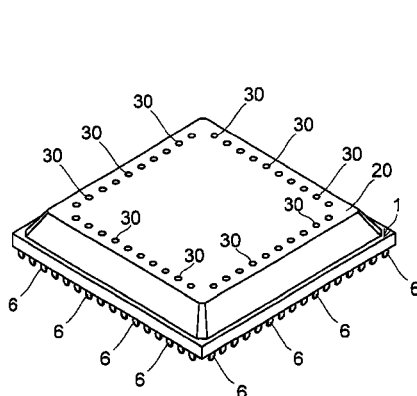
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(57)

ABSTRACT

There is provided a resin-sealed semiconductor device (BGA type semiconductor device) whose heat dissipating characteristic is improved, so that it is prevented from deteriorating in reliability. This BGA type semiconductor device includes a wiring substrate on a predetermined area on which a semiconductor chip is mounted; a plurality of metal bumps that are formed to be arranged at predetermined intervals in an area of the substrate different from the area on which the semiconductor chip is mounted; and a sealing resin layer that covers at least the semiconductor chip. Each of the plurality of metal bumps is covered with the sealing resin layer described above, with a part thereof exposed at a top face of the sealing resin layer.

22 Claims, 4 Drawing Sheets



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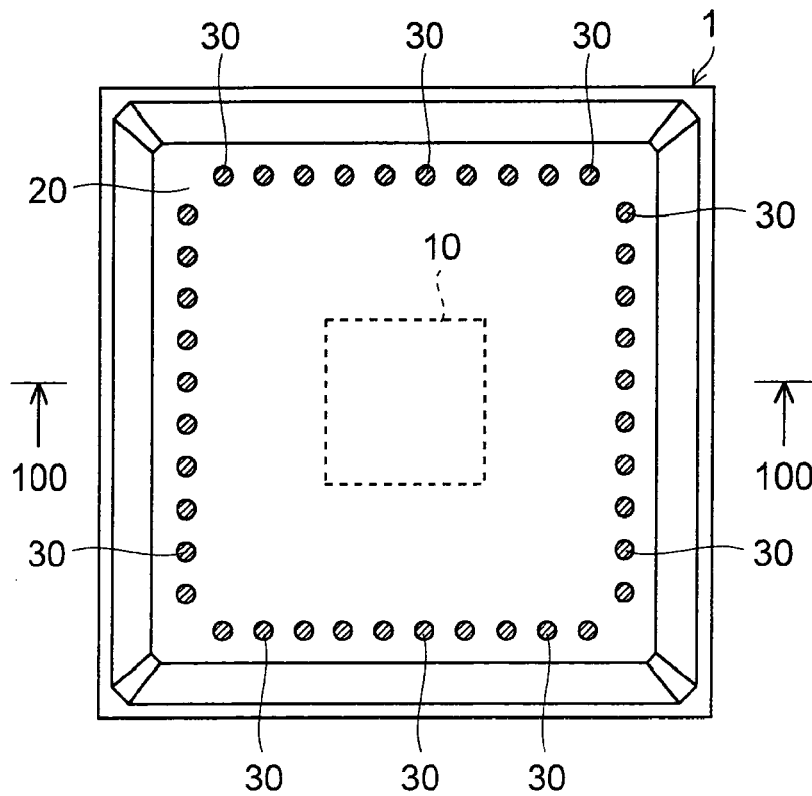


FIG.3

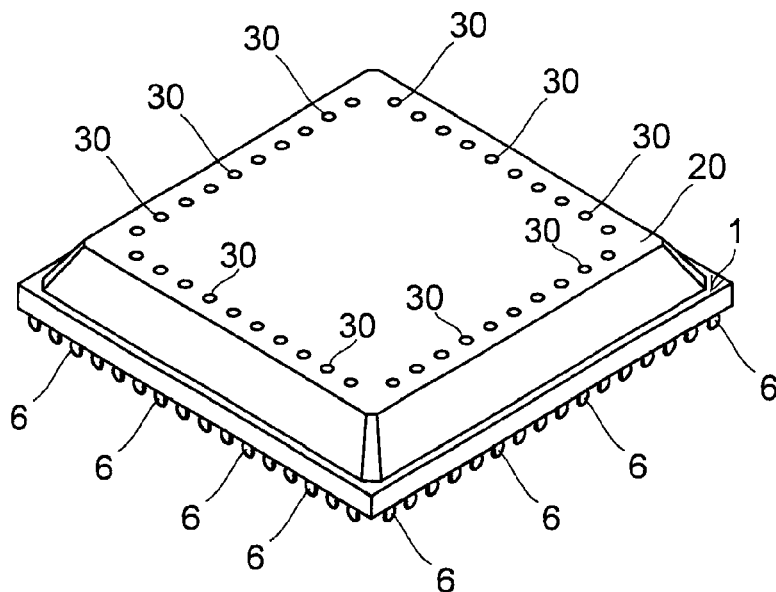


FIG.4

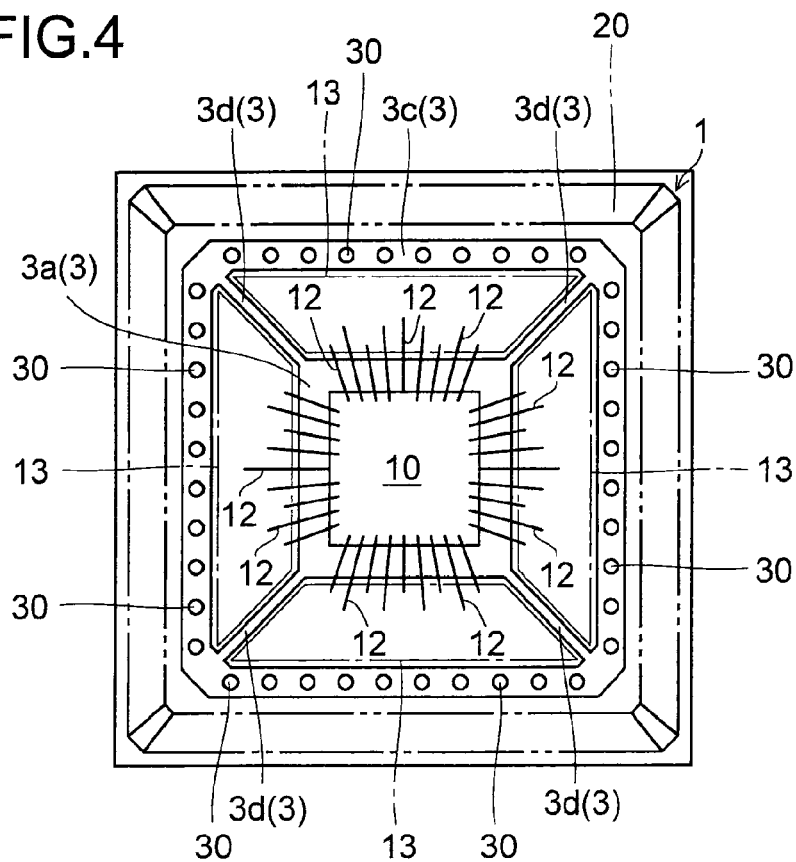


FIG.5

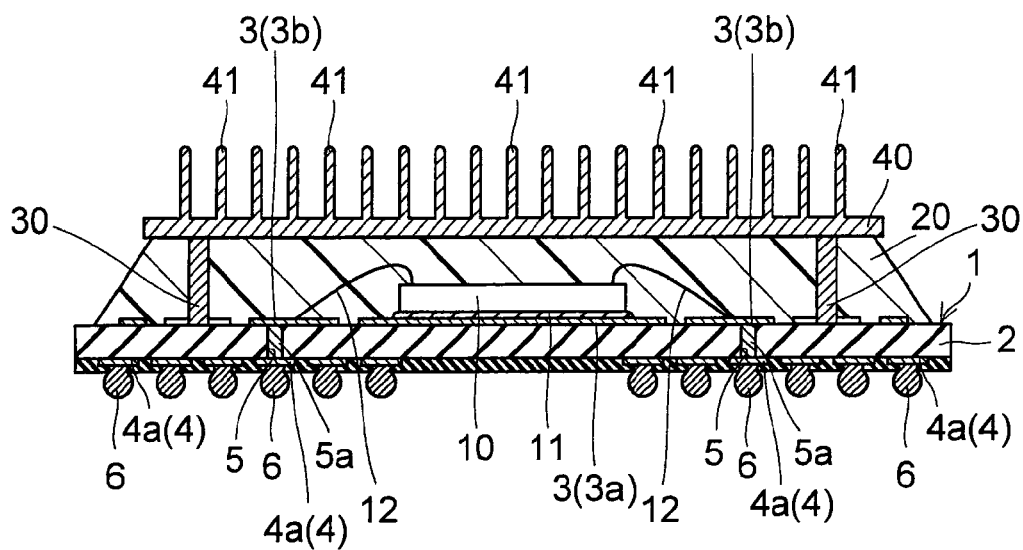


FIG.6

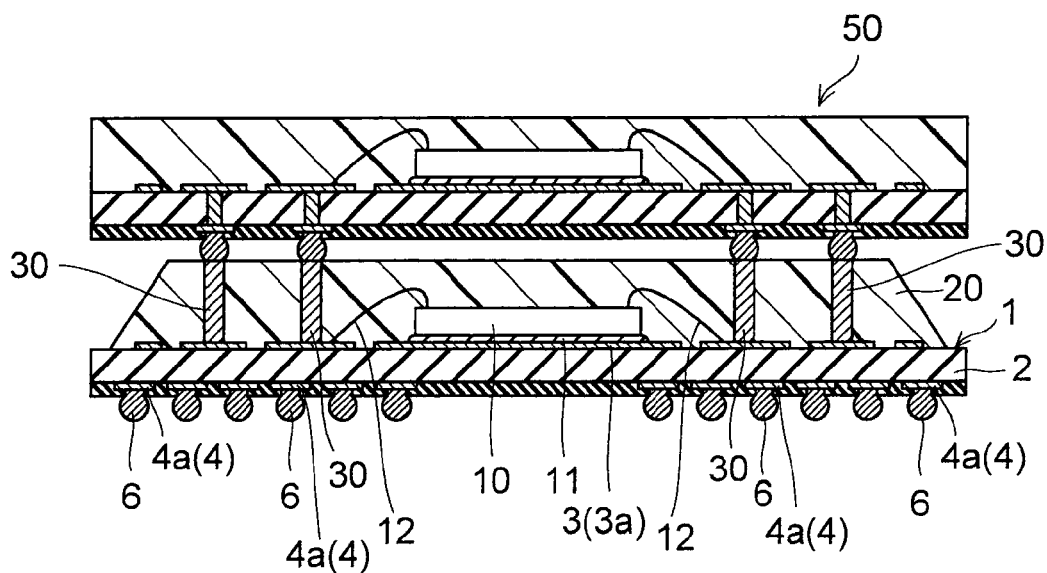


FIG.7

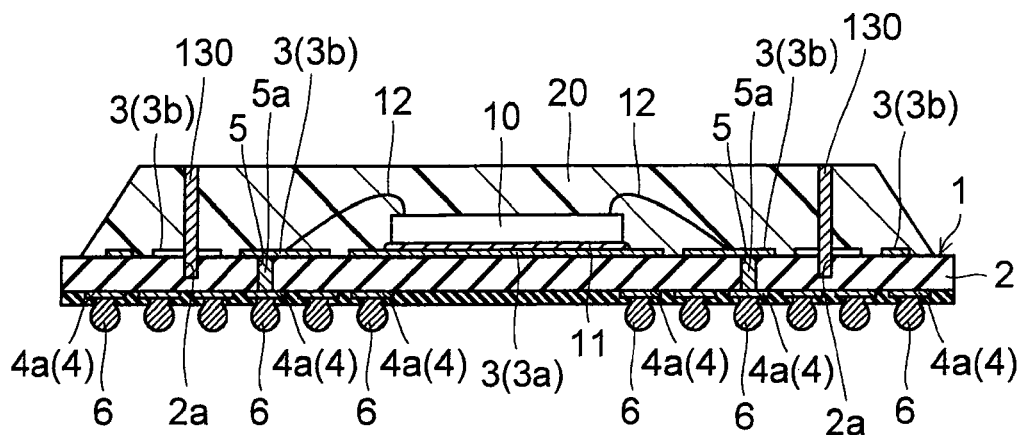
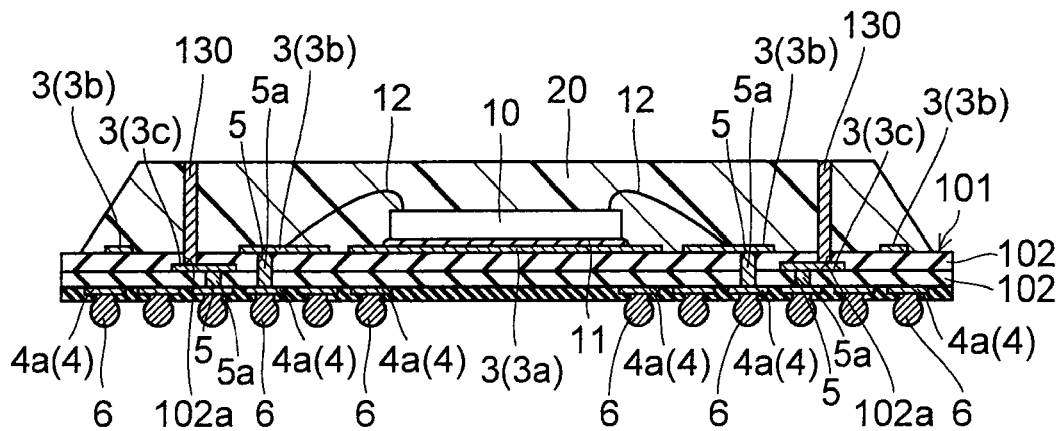


FIG.8



RESIN-SEALED SEMICONDUCTOR DEVICE

This application is based on Japanese Patent Application No. 2007-277269 filed on Oct. 25, 2007, the contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION**1. Field of the Invention**

The present invention relates to a resin-sealed semiconductor device, and particularly relates to a resin-seal type semiconductor device having a substrate on which a semiconductor chip is mounted.

2. Description of Related Art

Along with the recent increase in power consumption and integration of semiconductor devices, semiconductor devices have come to generate more heat in operation. Since such increase in heat generated by semiconductor devices in operation causes problems such as a malfunction and a shorter lifetime of a semiconductor element, there has been strong demand for improvement in heat dissipating characteristic of semiconductor devices.

A conventionally known way of meeting such demand is use of a resin-seal type semiconductor device that is capable of efficiently dissipating heat generated therein. An example of such a resin-seal type semiconductor device is disclosed in JP-A-H11-26658.

JP-A-H11-26658 mentioned above discloses a BGA (ball grid array) type semiconductor device, which is an example of a resin-seal type semiconductor device, having a structure in which a rough surface for heat dissipation is formed on a top face of a package (a sealing resin layer). In this conventional BGA type semiconductor device, the rough shape is formed on the top face of the package (the sealing resin layer), and thus the amount of surface area of the package (the sealing resin layer) can be increased; accordingly, the amount of area of the surface of the package that is in contact with air can be increased. This makes it possible for heat generated therein to be dissipated more efficiently compared with the case where no rough shape for heat dissipation is formed.

However, in the conventional BGA type semiconductor device disclosed in the above mentioned JP-A-H11-26658, although heat dissipating characteristic is improved to some extent by forming the rough shape on the surface of the package (the sealing resin layer), in a case where a semiconductor chip that generates a larger amount of heat is mounted, it is difficult to sufficiently dissipate heat that is generated in the semiconductor chip, which is inconvenient. As a result, it is difficult to prevent a malfunction of and a decrease in lifetime of a semiconductor element, and this causes the semiconductor device to inconveniently deteriorate in reliability.

SUMMARY OF THE INVENTION

The present invention has been made in order to solve the problems described above, and an object of the present invention is to provide a resin-sealed semiconductor device that has an improved heat dissipating characteristic and is thereby prevented from deteriorating in reliability.

To achieve the above object, according to the present invention, a resin-sealed semiconductor device includes: a substrate on a predetermined area of which a semiconductor chip is mounted; a plurality of heat dissipating members that are formed to be arranged at predetermined intervals in an area of the substrate different from the area on which the

semiconductor chip is mounted; and a sealing resin layer that covers the semiconductor chip and at least a part of the heat dissipating members.

In this resin-sealed semiconductor device according to the present invention, provision of the plurality of heat dissipating members that are formed to be arranged at predetermined intervals in the area of the substrate that is different from the area on which the semiconductor chip is mounted makes it easy for heat generated in the semiconductor chip to be dissipated outside. As a result, heat dissipating characteristic of the resin-sealed semiconductor device is improved, and thus, even in a case where a semiconductor chip that generates a larger amount of heat is mounted, heat generated in the semiconductor chip can be sufficiently dissipated. This helps prevent the semiconductor device from deteriorating in reliability.

In the above-described resin-sealed semiconductor device according to the present invention, it is preferable that at least one of the plurality of heat dissipating members be so formed that part thereof is exposed at a top face of the resin-seal type semiconductor device. With this structure, heat generated in the semiconductor chip can be easily dissipated outside via the exposed part of the heat dissipating members.

In this resin-sealed semiconductor device according to the present invention described above, it is preferable that the plurality of heat dissipating members be each formed of a metal cylinder and arranged to surround the semiconductor chip in plan view. With this structure, heat generated in the semiconductor chip can be dissipated outside more easily.

In the above-described structure in which a part of the heat dissipating members is exposed at the top face of the sealing resin layer, it is preferable that the resin-sealed semiconductor device further comprise a heat sink mounted on a top face of the resin sealing layer, and that the heat dissipating members be thermally connected to the heat sink. With this structure, heat generated in the semiconductor chip can be efficiently dissipated outside via the heat sink.

In the above-described structure in which a part of the heat dissipating members is exposed at the top face of the sealing resin layer, it is preferable that the substrate be a wiring substrate including a plurality of wiring layers each formed to have a predetermined wiring pattern, that the plurality of heat dissipating members be each formed of a conductive material, and that at least one of the plurality of heat dissipating members be electrically connected to a predetermined one of the wiring layers.

In the above-described resin-sealed semiconductor device according to the present invention, as a result of the semiconductor chip being sealed by the sealing resin layer, a BGA type package can be formed.

Thus, according to the present invention, as a result of heat dissipating characteristic being further improved, a resin-sealed semiconductor device that can be prevented from deteriorating in reliability can be easily achieved.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view showing a BGA type semiconductor device of a first embodiment of the present invention;

FIG. 2 is a plan view showing the BGA type semiconductor device of the first embodiment of the present invention;

FIG. 3 is an overall perspective view showing the BGA type semiconductor device of the first embodiment of the present invention;

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FIG. 4 is a plan view showing a modified example of the BGA type semiconductor device of the first embodiment of the present invention;

FIG. 5 is a sectional view showing a BGA type semiconductor device of a second embodiment of the present invention;

FIG. 6 is a sectional view showing a BGA type semiconductor device of a third embodiment of the present invention;

FIG. 7 is a sectional view showing a BGA type semiconductor device of a fourth embodiment of the present invention; and

FIG. 8 is a sectional view showing a BGA type semiconductor device of a fifth embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Hereinafter, detailed descriptions will be given of embodiments embodying the present invention with reference to the drawings. The embodiments described below will deal with cases where the present invention is applied to a BGA type semiconductor device which is an example of resin-seal type semiconductor devices.

First Embodiment

FIG. 1 is a sectional view showing a BGA type semiconductor device of a first embodiment of the present invention. FIG. 2 is a plan view showing the BGA type semiconductor device of the first embodiment of the present invention. FIG. 3 is an overall perspective view showing the BGA type semiconductor device of the first embodiment of the present invention. FIG. 1 is a sectional view taken along line 100-100 in FIG. 2. First, a description will be given of a structure of the BGA type semiconductor device of the first embodiment of the present invention, with reference to FIGS. 1 to 3.

The BGA type semiconductor device according to the first embodiment at least includes, as shown in FIG. 1, a wiring substrate 1, a semiconductor chip 10 that is mounted on the wiring substrate 1, and a sealing resin layer 20 that covers the semiconductor chip 10 at a top face of the wiring substrate 1. The wiring substrate 1 is an example of the "substrate" of the present invention.

The wiring substrate 1 is a double-sided substrate formed of a base material layer and a plurality of wiring layers 3 and a plurality of wiring layers 4 formed on a top face and a bottom face of the base material layer, respectively. The base material layer 2 of this wiring substrate 1 is formed of an insulating material such as a resin material, an organic polymer material, and a ceramics material. The wiring layers 3 and 4 of the wiring substrate 1 are formed of a conductive material such as copper. The plurality of wiring layers 3 formed on the top face of the base material layer 2 include a mounting section 3a on which the semiconductor chip 10 is mounted and connection electrode layers 3b; the plurality of wiring layers 4 formed on the bottom face of the base material layer 2 include connection electrode layers 4a. The wiring layers 3 and 4 of the wiring substrate 1 are each formed to have a predetermined pattern shape.

In the wiring substrate 1 (the base material layer 2), a plurality of through holes 5 are formed to penetrate there-through from the top face to the bottom face thereof in the thickness direction thereof. In these through holes 5, for example, plugs 5a made of a material such as metal are embedded. Via the just mentioned through holes 5 (the plugs

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5a), the connection electrode layers 3b on the top face side of the wiring substrate 1 and the connection electrode layers 4a on the bottom face side of the wiring substrate 1 are electrically connected to each other. Instead of embedding the plugs 5a in the through holes 5, a conductive layer may be formed on a side wall of each of the through holes 5. Or, the through holes 5 may be filled in after the conductive layer is formed on the side wall of each of the through holes 5.

The semiconductor chip 10 is structured, for example, such that an integrated circuit and the like (not shown) are formed on one principal face (the top face) of the semiconductor chip 10. This semiconductor chip 10 is fixed, via an adhesive layer 11 formed of solder or the like, on the mounting section 3a of the wiring substrate 1 such that one principal face of the semiconductor chip 10 (the face thereof on which the integrated circuit and the like are formed) is on an upper side (a side opposite to the wiring substrate 1). The semiconductor chip 10 is electrically connected to the connection electrode layers 3b on the top face side of the wiring substrate 1 via bonding wires 12 each made of, for example, a fine gold wire.

As shown in FIGS. 1 and 3, on the bottom face of the wiring substrate 1, a plurality of solder balls 6 are formed to function as external terminals. As shown in FIG. 1, these solder balls 6 are formed on the connection electrode layers 4a on the bottom face side of the wiring substrate 1. That is, the solder balls 6 are electrically connected to the semiconductor chip 10 via, for example, the through holes 5.

The sealing resin layer 20 is formed of, for example, a thermosetting resin such as epoxy resin, and is formed on the top face of the wiring substrate 1 so as to resin-seal components such as the semiconductor chip 10 and the bonding wires 12. This sealing resin layer 20 resin-seals the semiconductor chip 10, the bonding wires 12, and the like to protect them from gas and water.

Here, in the first embodiment, a plurality of metal bumps 30 made of copper are formed in a predetermined area (which is different from the area on which the semiconductor chip 10 is mounted) of the wiring substrate 1. As shown in FIGS. 1 and 2, the plurality of metal bumps 30 are arranged at predetermined intervals around the semiconductor chip 10. The metal bumps 30 are an example of the "heat dissipating members" and the "metal cylinders" of the present invention.

In the first embodiment, as shown in FIGS. 1 to 3, the plurality of metal bumps 30 are each covered by the above-described sealing resin layer 20 while a part thereof is exposed at the top face of the sealing resin layer 20. This structure can be obtained by, for example, sealing the metal bumps 30 with the sealing resin layer 20 and then grinding the top face of the sealing resin layer 20 to remove a predetermined amount thereof. Incidentally, in this case, the top face of the sealing resin layer 20 and the exposed part of the metal bumps 30 are flush with each other.

In the first embodiment, as described above, the provision of the plurality of metal bumps 30 arranged at predetermined intervals in the predetermined area of the wiring substrate 1 makes it easy for heat generated in the semiconductor chip 10 to be dissipated outside. As a result, heat dissipating characteristic of the BGA type semiconductor device can be improved, and thus, even in a case where a semiconductor chip that generates a large amount of heat is mounted, heat generated in the semiconductor chip can be sufficiently dissipated. This helps prevent the semiconductor device from deteriorating in reliability.

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Also, in the first embodiment, the plurality of metal bumps **30** are each formed such that a part thereof is exposed at the top face of the sealing resin layer **20**, and thus heat generated in the semiconductor chip **10** can be easily dissipated outside via the exposed part of each of the metal bumps **30**.

FIG. **4** is a plan view showing a modified example of the BGA type semiconductor device of the first embodiment of the present invention. As shown in FIGS. **1** and **4**, in the modified example of the BGA type semiconductor device of the first embodiment, the plurality of wiring layers **3** formed on the top face of the base material layer **2** (see FIG. **1**) further include a conductive layer **3c** for heat dissipation and four connection sections **3d** for thermally connecting this conductive layer **3c** for heat dissipation to the mounting section **3a** on which the semiconductor chip **10** is mounted.

The conductive layer **3c** for heat dissipation is formed in an area in the vicinity of a periphery of the wiring substrate **1** to have a frame shape that surrounds the semiconductor chip **10** and the bonding wires **12** in plan view. The four connection sections **3d** are arranged one at each of four corners of the mounting section **3a**, and are formed to radiate outward in plan view. The conductive layer **3c** for heat dissipation, the four connection sections **3d**, and the mounting section **3a** are connected to one another as one piece. The connection electrode layers **3b** (see FIG. **1**) that are electrically connected to the semiconductor chip **10** via the bonding wires **12** is formed in each of areas **13** that are surrounded by the mounting section **3a**, the conductive layer **3c**, and the connection sections **3d**. Also, on the top face of the conductive layer **3c** for heat dissipation, the metal bumps **30** described above are formed.

Incidentally, the modified example of the first embodiment is otherwise structured in the same manner as the first embodiment described above.

In the modified example of the first embodiment, as described above, not only the plurality of metal bumps **30** are formed on the conductive layer **3c** for heat dissipation, but also the conductive layer **3c** for heat dissipation and the mounting section **3a** on which the semiconductor chip **10** is mounted are thermally connected to each other via the connection sections **3d**, and as a result, heat generated in the semiconductor chip **10** can be easily transmitted to the metal bumps **30**. Thus, heat generated in the semiconductor chip **10** can be easily dissipated outside via the plurality of metal bumps **30**.

Incidentally, the modified example of the first embodiment also has all the advantages that the above-described first embodiment has.

Second Embodiment

FIG. **5** is a sectional view showing a BGA type semiconductor device of a second embodiment of the present invention. As shown in FIG. **5**, the BGA type semiconductor device of this second embodiment is the BGA type semiconductor device of the first embodiment described above further including a heat sink **40**. This heat sink **40** is formed of a metal material such as aluminum that is highly thermally conductive, and it has a plurality of heat dissipating fins **41**. The heat sink **40** is fixed to the top face of the sealing resin layer **20** such that it is thermally connected to each one of the plurality of metal bumps **30**.

Incidentally, the second embodiment is otherwise structured in the same manner as the first embodiment described above.

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In the second embodiment, as a result of the heat sink **40** that is thermally connected to the metal bumps **30** being provided on the top face of the sealing resin layer **20** as described above, heat generated in the semiconductor chip **10** can be effectively dissipated outside via this heat sink **40**.

Incidentally, the second embodiment also has all the advantages that the above-described first embodiment has.

Third Embodiment

FIG. **6** is a sectional view showing a BGA type semiconductor device of a third embodiment of the present invention. As shown in FIG. **6**, in this BGA type semiconductor device of the third embodiment, at least one of the plurality of metal bumps **30** is formed to be electrically connected to a predetermined one of the connection electrode layers **3b**. This enables the at least one of the metal bumps **30** that is electrically connected to the predetermined one of the connection electrode layers **3b** to function as an electric conductor.

With the BGA type semiconductor device of the third embodiment structured as described above, when another semiconductor device **50** is mounted on the BGA type semiconductor device to form a package-on-package (PoP) structure, the upper-side semiconductor device **50** can be electrically connected to the lower-side BGA type semiconductor device easily. And in a case where the semiconductor device **50** that is placed on the upper side is provided with heat dissipation measures, heat from the BGA type semiconductor device can be dissipated from the semiconductor device **50**.

Incidentally, the third embodiment is otherwise structured in the same manner as the first embodiment described above, and also has all the advantages that the above-described first embodiment has.

Fourth Embodiment

FIG. **7** is a sectional view showing a BGA type semiconductor device of a fourth embodiment of the present invention. As shown in FIGS. **1** and **7**, in this BGA type semiconductor device of the fourth embodiment, unlike in the first to third embodiments described above, the wiring substrate **1** is provided with metal pins **130** (see FIG. **7**) instead of the metal bumps **30** (see FIG. **1**). The metal pins **130** are an example of the "heat dissipating member" and the "metal cylinder" of the present invention. These metal pins **130** are formed of copper that is highly thermally conductive, and are fixed to the wiring substrate **1** such that they extend in a thickness direction of the semiconductor chip **10**. Specifically, in a predetermined area of the wiring substrate **1**, a plurality of recesses **2a** are formed to have a predetermined depth in a thickness direction of the wiring substrate **1** from the top face thereof; the above-described metal pins **130** are inserted one into each of the plurality of recesses **2a**.

In the fourth embodiment, as a result of the plurality of metal pins **130** being provided on the wiring substrate **1** as described above, heat generated in the semiconductor chip **10** can be dissipated outside easily as in the first to the third embodiments described above.

Also, in the fourth embodiment, as a result of the plurality of metal pins **130** being provided on the wiring substrate **1**, heat dissipating characteristic can be improved, and in addition, the semiconductor chip **10** can be prevented from warping.

The fourth embodiment is otherwise structured in the same manner as the first, the second, or the third embodi-

ment described above. And the fourth embodiment also has all the advantages that the above-described first embodiment has.

Fifth Embodiment

FIG. 8 is a sectional view showing a BGA type semiconductor device of a fifth embodiment of the present invention. A description will be given of a structure of the BGA semiconductor device of the fifth embodiment of the present invention with reference to FIG. 8.

Unlike the BGA type semiconductor devices of the first to the fourth embodiments described above, the BGA type semiconductor device of the fifth embodiment has a wiring substrate **101** formed of a multi-layer substrate. Specifically, the wiring substrate **101** is formed of a plurality of base material layers **102** laid on top of one another. On a top face and a bottom face of the base material layer **102**, wiring layers **3** and wiring layers **4** are formed. This base material layer **102** is formed of, for example, an insulating material such as a resin material, an organic polymer material, and a ceramics material. The wiring layers **3** and **4** of the wiring substrate **101** (the base material layers **102**) are each formed of a conductive material such as copper. Furthermore, the wiring layers **3** of the wiring substrate **101** (the base material layers **102**) include a mounting section **3a** that is formed on a top face of the wiring substrate **101** and on which a semiconductor chip **10** is mounted, connection electrode layers **3b** that are also formed on the top face of the wiring substrate **101**, and inner wiring layers **3c** that are formed at an inner layer side. On the other hand, the wiring layers **4** of the wiring substrate **101** (the base material layers **102**) include connection electrode layers **4a** that are formed on the bottom face of the wiring substrate **101**. Incidentally, the wiring substrate **101** is an example of the “substrate” of the present invention.

Also, in a predetermined part of the wiring substrate **101** (the base material layers **102**), through holes (via holes) **5** are formed for electrically connecting the wiring layers at the upper-layer side to those at the lower-layer side. In each of these through holes (via holes) **5**, for example, a plug **5a** made of a material such as a metal material is embedded. Instead of embedding a plug **5a** in each of the through holes (via holes) **5**, a conductive layer may be formed on a side wall of each of the through holes **5**. Or, the through holes **5** may be filled in after the conductive layer is formed on the side wall of each of the through holes **5**.

Also, in the fifth embodiment, as in the fourth embodiment described above, the wiring substrate **101** is provided with a plurality of metal pins **130**. The metal pins **130** are formed of copper that is highly thermally conductive, and is fixed to the wiring substrate **101** such that they extend in a thickness direction of the semiconductor chip **10**. Specifically, in a predetermined area of the wiring substrate **101**, a plurality of recesses **102a** are formed to have a predetermined depth in a thickness direction of the wiring substrate **1** from the top face thereof, and the above-described metal pins **130** are inserted one into each of the plurality of recesses **102a**.

Here, in the fifth embodiment, at least one of the plurality of recesses **102a** is located in an area corresponding to any one of the inner wiring layers **3c**. Also, these recesses **102a** are formed deep enough to reach the inner wiring layers **3c**. Thus, the at least one of the recesses **102a** that is located in an area corresponding to any one of the inner wiring layers **3c** allows the metal pin **130** that is inserted therinto to be electrically connected to the inner wiring layer **3c** of the

wiring substrate **101**. That is, at least one of the plurality of metal pins **130**, the metal pins **130** each being inserted into a corresponding one of the plurality of recesses **102a**, is electrically connected to a corresponding one of the inner wiring layers **3c** of the wiring substrate **101**.

In the BGA semiconductor device of the fifth embodiment having the above-described structure, as a result of at least one of the plurality of metal pins **130** being electrically connected to a corresponding one of the inner wiring layers **3c**, the at least one of the metal pins **130** that is electrically connected to the corresponding inner wiring layer **3c** can function as an electric conductor.

Incidentally, the fifth embodiment is otherwise structured in the same manner as the fourth embodiment described above. And the fifth embodiment also has all the advantages the above-described first to fourth embodiments have.

Incidentally, it should be understood that the embodiments disclosed in this application are presented only by way of example in all respects and do not limit the present invention in any manner. The scope of the present invention is determined from the appended claims rather than from the aforementioned detailed descriptions of preferred embodiments but by the appended claims, and further, it is intended by the appended claims to cover all modifications of the present invention which fall within the true spirit and scope of the invention and its equivalents.

For example, although the first to the fifth embodiments described above deal with the cases in which the present invention is applied to a BGA type semiconductor device exemplifying resin-seal type semiconductor devices, but this is not meant to limit the present invention in any manner, and the present invention may be applied to any other type of resin-seal type semiconductor device.

Also, although the first to the fifth embodiments described above deal with the cases in which a part of heat dissipating members (metal bumps or metal pins) is exposed at a top face of a resin sealing layer, but this is not meant to limit the present invention, and a structure may be adopted in which no part of the heat dissipating members is exposed out of the sealing-resin layer. Also, a structure may be adopted in which at least one of the plurality of heat dissipating members has a part thereof exposed at the top face of the sealing-resin layer.

Also, although the first to the fifth embodiments described above deal with the cases in which a plurality of heat dissipating members (metal bumps or metal pins) are arranged so as to surround semiconductor chip in plan view, but this is not meant to limit the present invention, and the plurality of heat dissipating members (the metal bumps or the metal pins) may be arranged in a manner different from those in the first to the fifth embodiments described above.

Incidentally, although the first to the fifth embodiments described above deal with the cases in which metal bumps or metal pins are used as an example of heat dissipating members, but this is not meant to limit the present invention, and heat dissipating members other than metal bumps and metal pins may be used. Also, heat dissipating members having any shape other than a metal cylinder shape may be used.

Also, although the first to the fourth embodiments described above deal with the cases in which a BGA type semiconductor device (resin-seal type semiconductor device) is formed of a wiring substrate that is a double-sided substrate, but this is not meant to limit the present invention in any manner, and the BGA type semiconductor device

(resin-seal type semiconductor device) may be formed of a wiring substrate rather than a double-sided substrate such as a multilayer substrate.

Also, although the first to the third embodiments described above deal with the cases in which metal bumps are formed of copper (Cu), but this is not meant to limit the present invention, and the metal bumps may be formed of a metal material other than copper (Cu). For example, the metal bumps may be formed of aluminum (Al).

The modified example of the first embodiment described above deals with the case where a conductive layer for heat dissipation is formed in a frame shape and the conductive layer for heat dissipation and a mounting section are thermally connected to each other via four connection sections that are formed to radiate outward from the mounting section, but this is not meant to limit the present invention, and the conductive layer for heat dissipation and the connection sections may be structured differently from those shown in the above-described structure (the structure shown in the modified example of the first embodiment described above).

The fourth and the fifth embodiments described above deal with the examples in which metal pins are formed of copper (Cu), but this is not meant to limit the present invention, and the metal pins may be formed of a metal material other than copper (Cu). For example, the metal pins may be formed of aluminum (Al).

What is claimed is:

1. A resin-sealed semiconductor device comprising:

a substrate having a base material layer formed of an insulating material and a plurality of wiring layers formed of an electrically conductive material, the substrate having a semiconductor chip mounted on a top face thereof;

a bonding wire;

an external connection electrode on a bottom face of the base material layer of the substrate, the external connection electrode having a solder ball provided thereon;

a plurality of metal cylinders, each of the metal cylinders having a bottom face thereof in contact with the substrate; and

a sealing resin layer that covers the semiconductor chip and the metal cylinders except a top face of each of the metal cylinders,

wherein

the wiring layers are formed at least on a top face and the bottom face of the base material layer,

the sealing resin layer is formed of a different material from the base material layer, and completely covers the wiring layers formed on the top face of the base material layer,

the wiring layers include a first wiring layer, a second wiring layer, a third wiring layer, and the external connection electrode,

the first wiring layer and the second wiring layer are formed on the top face of the base material layer,

the semiconductor chip is fixed on the first wiring layer via an adhesive layer, and is electrically connected to the second wiring layer via the bonding wire,

the second wiring layer is disposed outside the first wiring layer, and is apart from the third wiring layer,

the third wiring layer is disposed outside the second wiring layer, and is apart from the bonding wire,

the bottom face or a side face of each of the metal cylinders is connected to the third wiring layer,

the metal cylinders enclose the semiconductor chip at predetermined intervals along edges of the semiconductor chip such that the metal cylinders are arranged in a quadrangular shape,

the third wiring layer is formed so as to enclose the first wiring layer,

four connection sections connect the first wiring layer to the third wiring layer,

the four connection sections are provided, one at each of four corners of the first wiring layer,

the four connection sections radiate outward in plan view, the first wiring layer, the four connection sections, and the third wiring layer are connected to one another as one piece.

2. A resin-sealed semiconductor device comprising:

a substrate having a base material layer formed of an insulating material and a plurality of wiring layers formed of an electrically conductive material, the substrate having a semiconductor chip mounted on a top face thereof;

a bonding wire;

an external connection electrode on a bottom face of the base material layer of the substrate, the external connection electrode having a solder ball provided thereon;

a plurality of metal cylinders, each of the metal cylinders having a bottom face thereof in contact with the substrate; and

a sealing resin layer that covers the top face of the substrate, the metal cylinders except a top face of each of the metal cylinders, and the semiconductor chip,

wherein

the wiring layers are formed at least on a top face and the bottom face of the base material layer,

the sealing resin layer is formed of a different material from the base material layer, and completely covers the wiring layers formed on the top face of the base material layer,

the wiring layers include a first wiring layer, a second wiring layer, a third wiring layer, and the external connection electrode,

the first wiring layer and the second wiring layer are formed on the top face of the base material layer,

the semiconductor chip is fixed on the first wiring layer via an adhesive layer, and is electrically connected to the second wiring layer via the bonding wire,

the second wiring layer is disposed outside the first wiring layer, and is apart from the third wiring layer,

the third wiring layer is disposed outside the second wiring layer, and is apart from the bonding wire,

the bottom face or a side face of each of the metal cylinders is connected to the third wiring layer,

the metal cylinders enclose the semiconductor chip at predetermined intervals along edges of the semiconductor chip such that the metal cylinders are arranged in a quadrangular shape,

the third wiring layer is formed so as to enclose the first wiring layer,

four connection sections connect the first wiring layer to the third wiring layer,

the four connection sections are provided, one at each of four corners of the first wiring layer,

the four connection sections radiates outward in plan view,

the first wiring layer, the four connection sections, and the third wiring layer are connected to one another as one piece.

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3. The resin-sealed semiconductor device of claim 1 further comprising a heat sink mounted on the top face of the resin sealing layer, wherein the metal cylinders are thermally connected to the heat sink.

4. The resin-sealed semiconductor device of claim 1 wherein the second wiring layer is formed in an area surrounded by the first wiring layer, the third wiring layer, and the four connection sections.

5. The resin-sealed semiconductor device of claim 1 wherein the bottom face of each of the metal cylinders is connected to the third wiring layer.

6. The resin-sealed semiconductor device of claim 3 wherein the heat sink is formed of aluminum.

7. The resin-sealed semiconductor device of claim 1 wherein the metal cylinders are formed of copper or aluminum.

8. The resin-sealed semiconductor device of claim 1 wherein the metal cylinders are along sides of the substrate.

9. The resin-sealed semiconductor device of claim 2 further comprising a heat sink mounted on the top face of the resin sealing layer, wherein the metal cylinders are thermally connected to the heat sink.

10. The resin-sealed semiconductor device of claim 2 wherein the second wiring layer is formed in an area surrounded by the first wiring layer, the third wiring layer, and the four connection sections.

11. The resin-sealed semiconductor device of claim 2 wherein the bottom face of each of the metal cylinders is connected to the third wiring layer.

12. The resin-sealed semiconductor device of claim 9 wherein the heat sink is formed of aluminum.

13. The resin-sealed semiconductor device of claim 2 wherein the metal cylinders are formed of copper or aluminum.

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14. The resin-sealed semiconductor device of claim 2 wherein the metal cylinders are along sides of the substrate.

15. The resin-sealed semiconductor device of claim 1 wherein the first wiring layer, the second wiring layer, and the third wiring layer are in contact with the base material layer.

16. The resin-sealed semiconductor device of claim 2 wherein the first wiring layer, the second wiring layer, and the third wiring layer are in contact with the base material layer.

17. The resin-sealed semiconductor device of claim 1 wherein the first wiring layer, the third wiring layer, and the external connection electrode are apart from the bonding wire.

18. The resin-sealed semiconductor device of claim 2 wherein the first wiring layer, the third wiring layer, and the external connection electrode are apart from the bonding wire.

19. The resin-sealed semiconductor device of claim 1 wherein the third wiring layer is formed on the top face of the base material layer.

20. The resin-sealed semiconductor device of claim 2 wherein the third wiring layer is formed on the top face of the base material layer.

21. The resin-sealed semiconductor device of claim 1 wherein the second wiring layer is disposed apart from the first wiring layer.

22. The resin-sealed semiconductor device of claim 2 wherein the second wiring layer is disposed apart from the first wiring layer.

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